

NOAA Air Quality Forecast Modeling Program

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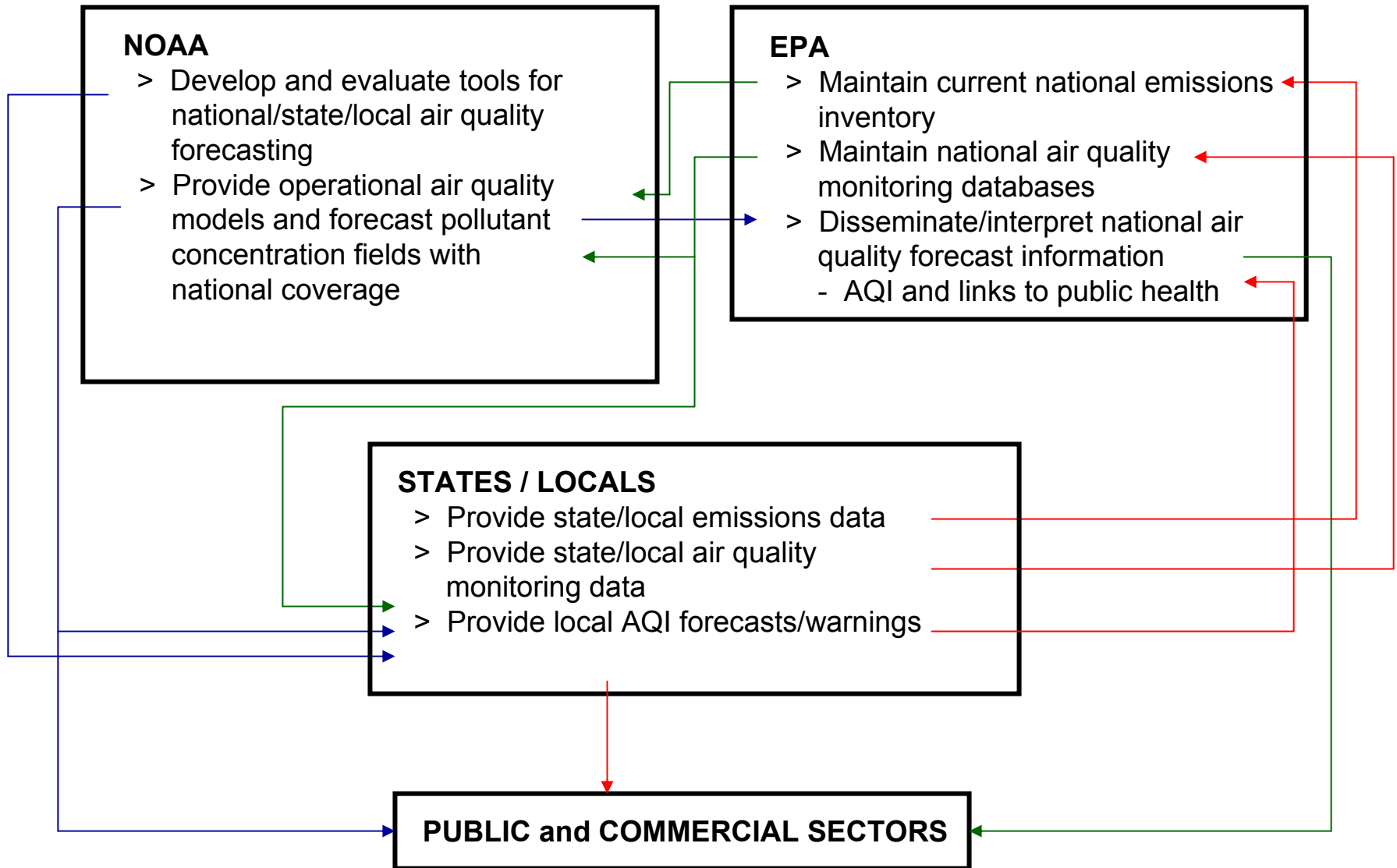
NOAA-Air Resources Laboratory
U.S. EPA-Atmospheric Modeling Division
Research Triangle Park, NC

U.S. EPA/AWMA 2003 National Air Quality Conference
San Antonio, TX
February 4, 2003

OVERVIEW

- Motivation
 - To provide accurate and timely air quality forecast guidance Nationwide to help protect lives and property
 - Public interest / Congressional interest
 - 2002 Senate Energy Bill
 - “... NOAA shall ... establish a program to provide operational air quality forecasts and warnings for specific regions of the United States ...”
- Collaboration

PARTNERSHIPS IN AIR QUALITY FORECASTING



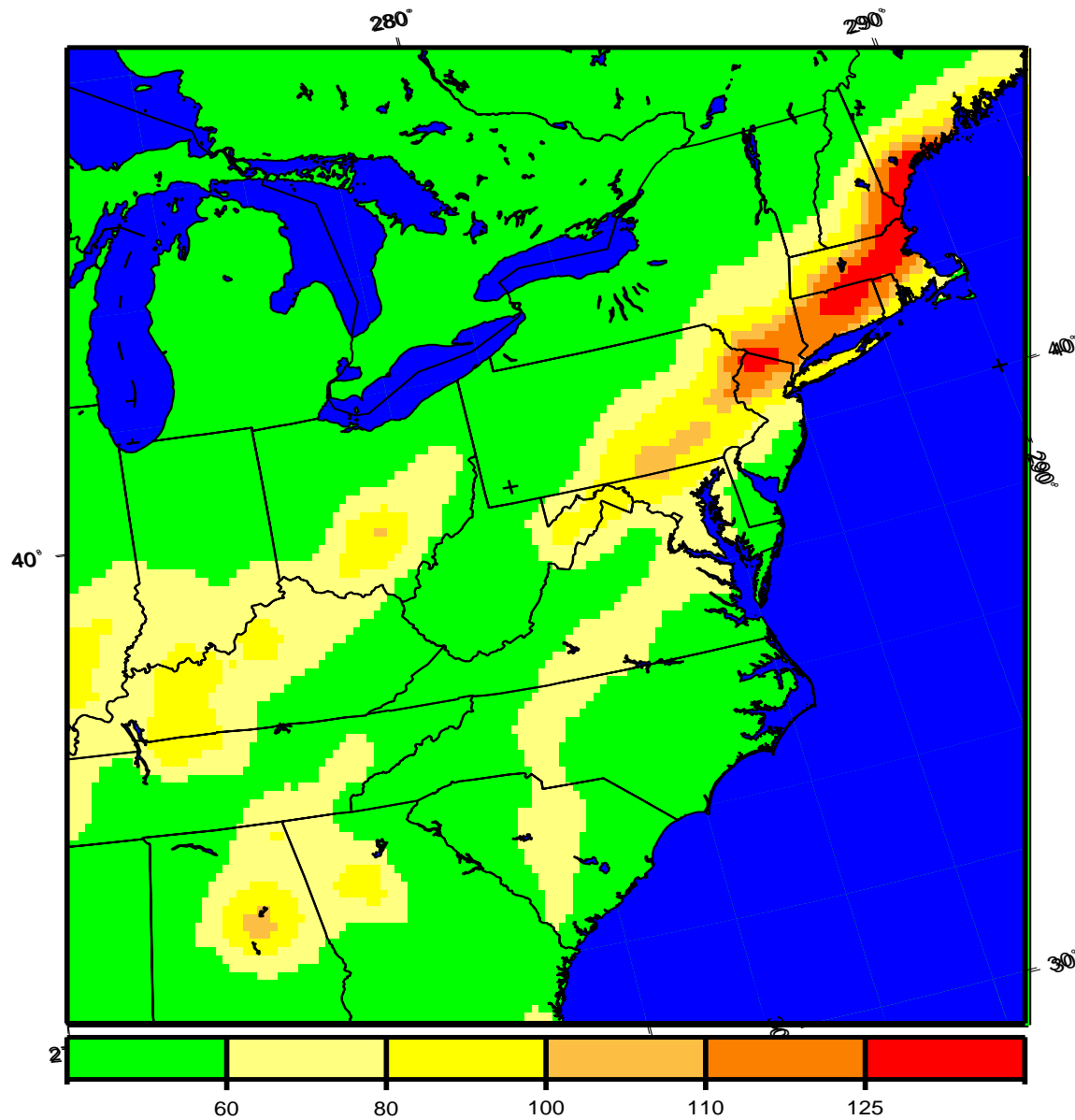
- Tentative Operational Timetable
 - Initial Operational Capability
 - 1-day ozone forecasts for the Northeast U.S. – Fall 2004
 - 1-day ozone forecasts Nationwide – within 5 yrs
 - 1-day PM2.5 forecasts for the Northeast U.S. – within 5 yrs
 - Extensions to Operational Capability
 - Over 10 yr period
 - 2-3 day ozone forecasts Nationwide
 - 2-3 day PM2.5 forecasts Nationwide
 - Associated forecast metrics (e.g., visibility)
 - Development and extension of operational performance goals

Research Prototyping Activities

- 2001, 2002 NOAA Early Start and Air Quality Pilot Studies
 - Daily numerical model forecasts for ozone made during summer season with existing air quality models
 - Northeast/East U.S. domains
 - MCNC MAQSIP-RT
 - NOAA/ARL Hysplit-O₃
 - NOAA/FSL MM5-Chem

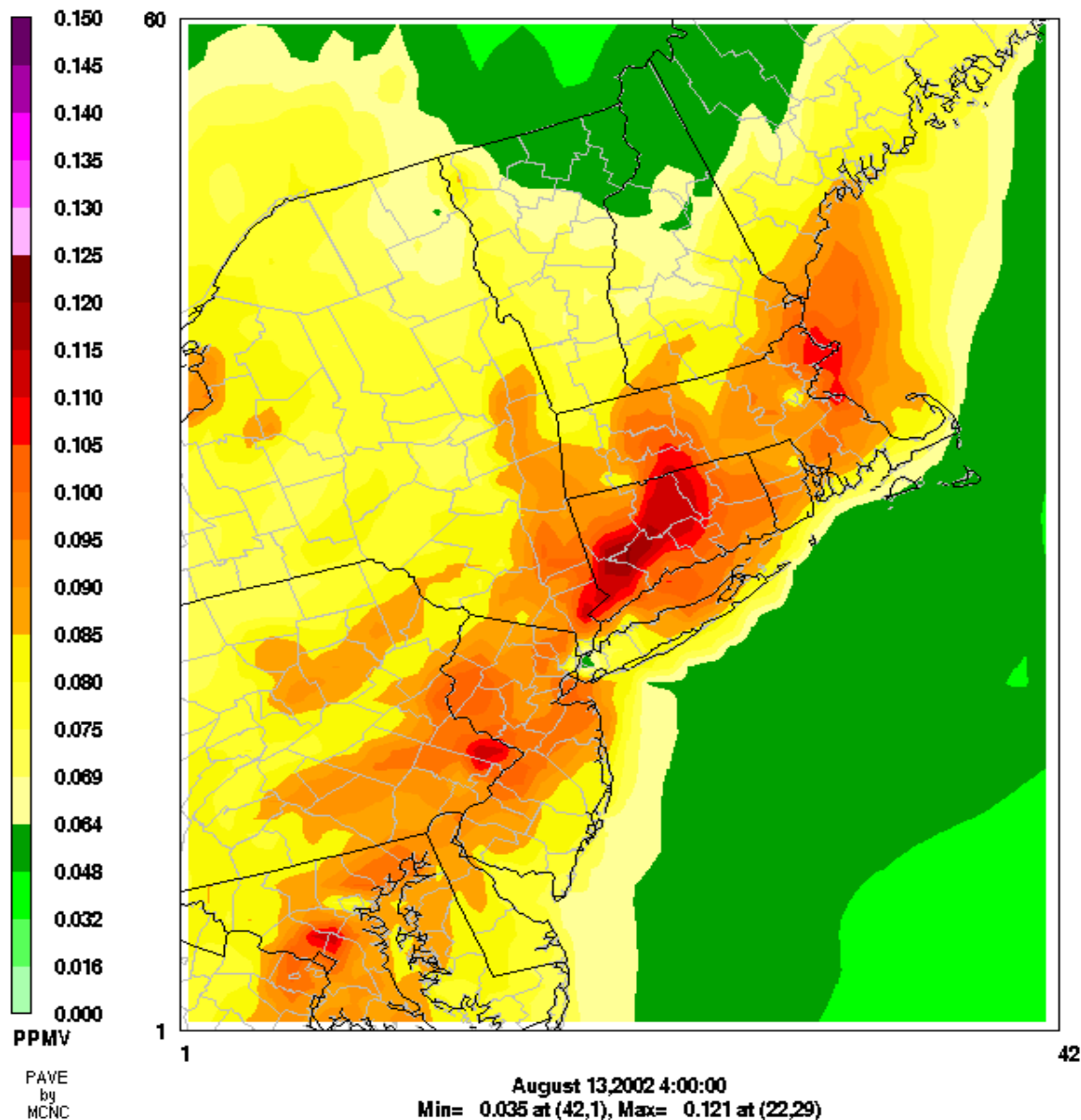
Ozone Peak Values - HYSPLIT

July 23, 2002



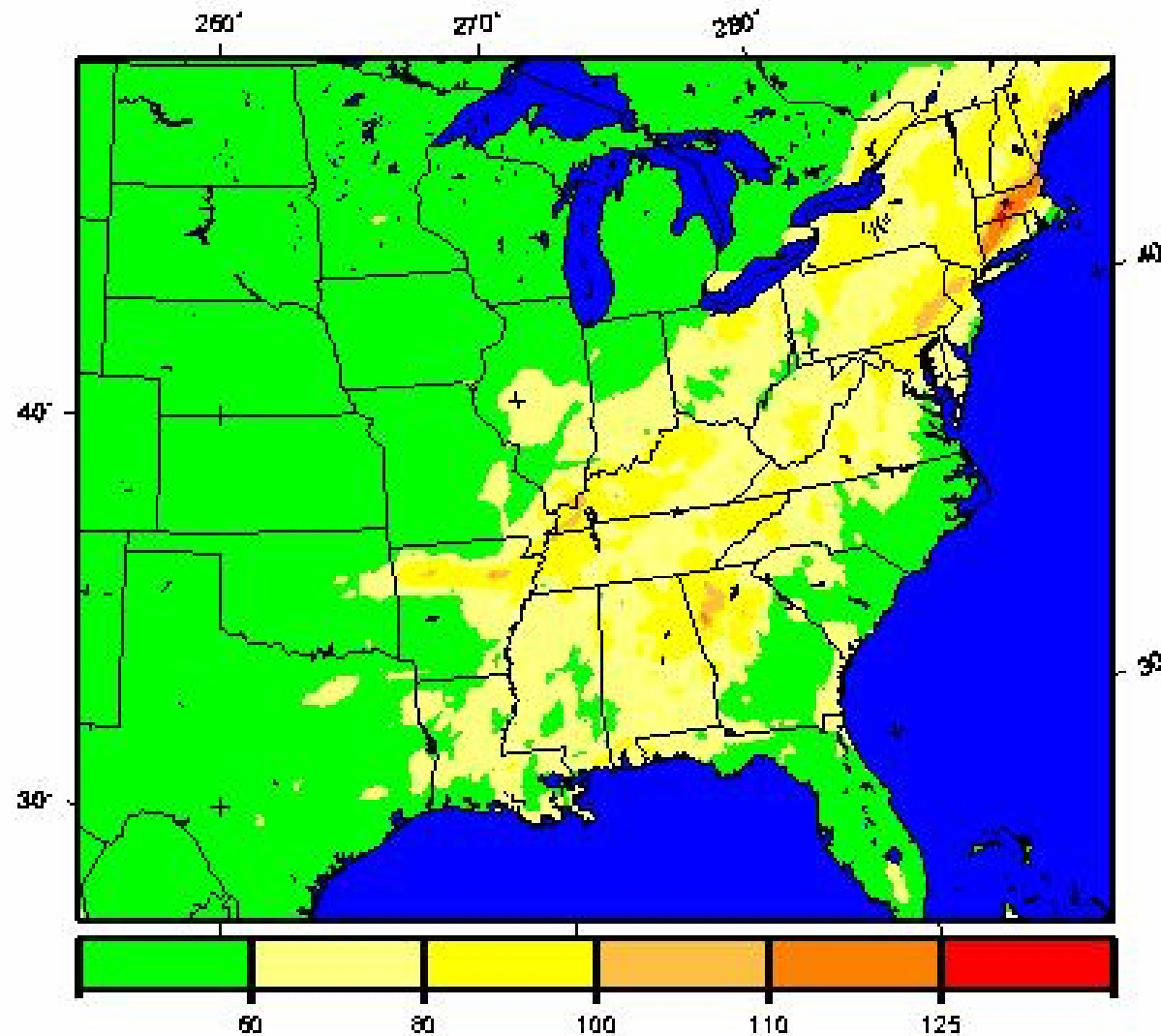
24HR Peak 8HR-AVE Ozone -- NE Corridor

NOAA New England 15km
MCNC Forecast Initialized at: 2002081300



Predicted (mm5/chem) Ozone Peak Values (ppb)

July 22, 2002



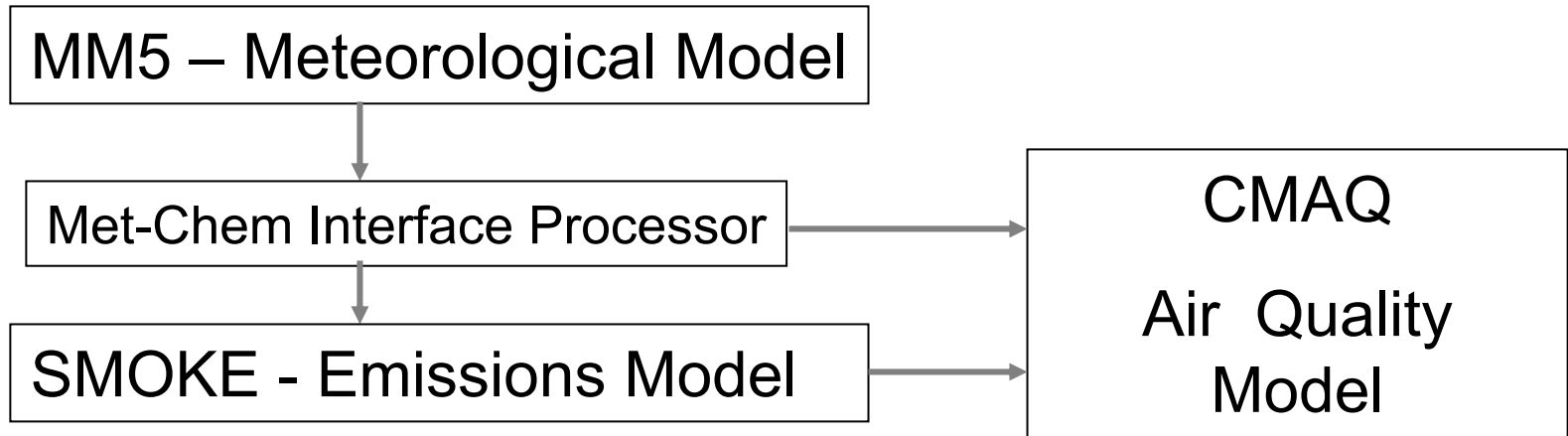
Max 8-hr Ozone

	Summary Statistics		Discrete Evaluation		Categorical Evaluation	
	MAQSIP	AIRS	MAQSIP = $20.1 + 0.66(\text{AIRS})$		Ozone ≤ 85 ppb	
Mean	50.2	45.6	R	0.62		
SD	18.9	17.8	BIASES			
CV	37.7	39.0	MB	4.6		
Max	135.5	133.5	MNB	22.1%	A	95.3%
95 th	84.7	77.4	MFB	9.7%	B	1.89
75 th	62.4	56.4	NMB	10.2%		
50 th	46.7	43.1	ERRORS		FAR	71.2%
25 th	36.0	32.7	NME	27.9%	CSI	23.2%
5 th	25.1	21.2	RMSE	16.7		
Min	0	1	MAGE	12.7	POD	54.6%
n	13,032	13,032	MNGE	37.3%	SS	-

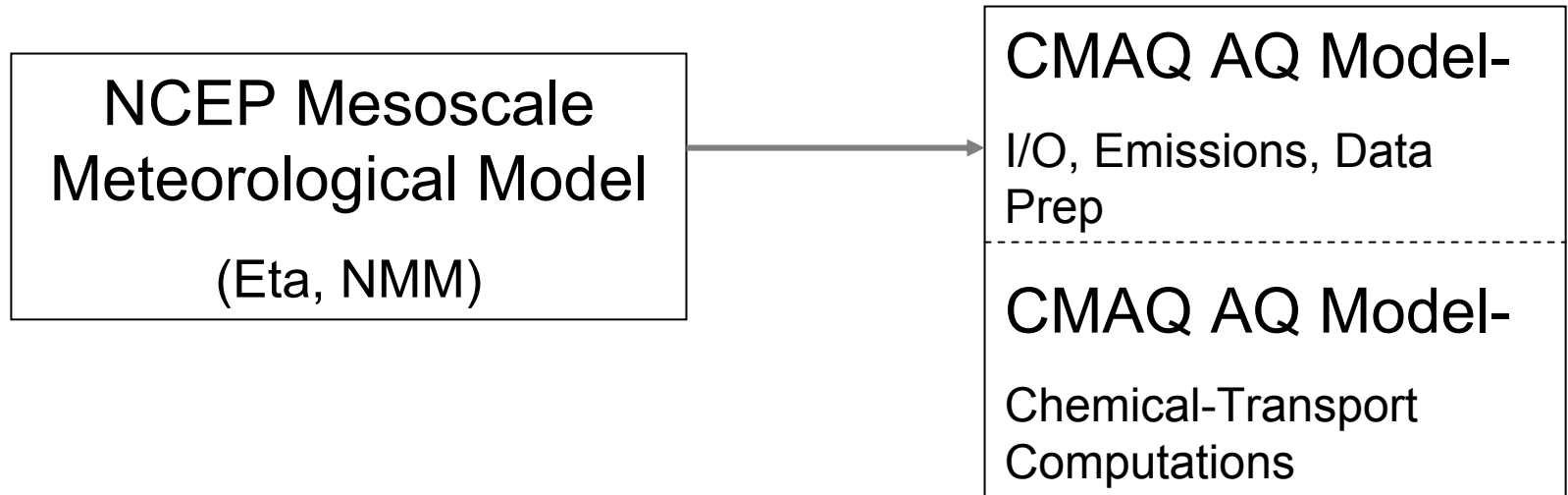
Building an Operational Capability

- NOAA/NCEP Mesoscale Models
 - Eta model
 - Run 4X per day – Fully Operational
 - 12-km grid cells – Continental domain
 - Non-hydrostatic Mesoscale Model (NMM)
 - Run 1X per day per regional domain– operational, but may not run every day
 - 8-km grid cells – Regional domains
- EPA Mesoscale Air Quality Model
 - CMAQ model
 - Nested domains (2-36 km grid cells)

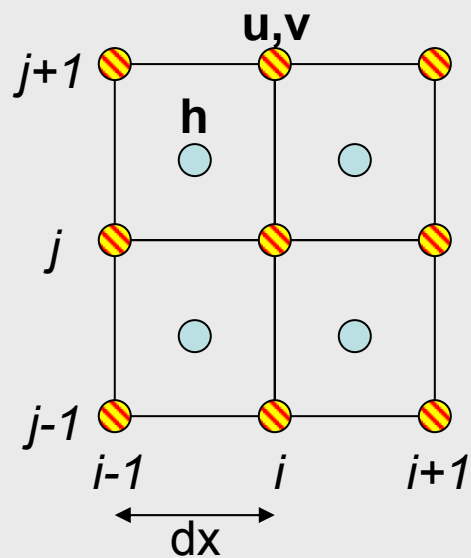
Current CMAQ Modeling System



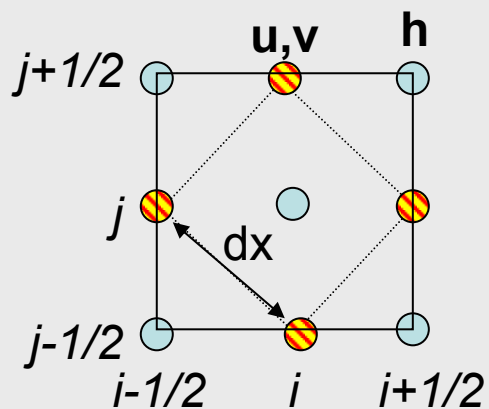
CMAQ Forecast System



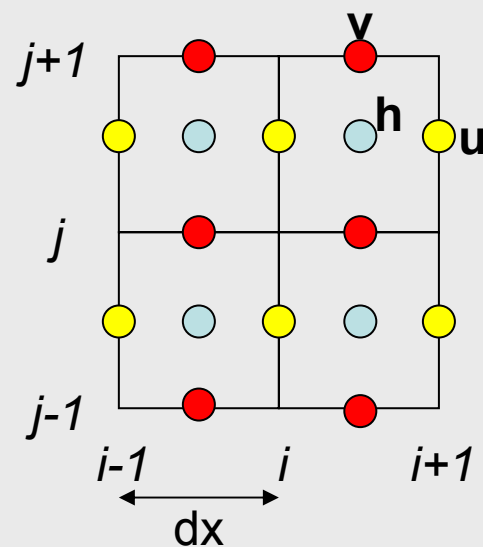
- Challenges in linking Eta and CMAQ models
 - Different horizontal coordinate systems and map projections
 - Different vertical coordinate systems
 - Maintaining mass consistency
 - Efficiency and accuracy of forecast system
 - Efficiency
 - Restructured CMAQ code
 - Parallel computing architecture
 - Accuracy
 - Operational target – to improve on a persistence forecast
 - IC/BC/Data Assimilation

B

Used by: MM5

E

Used by: Eta, NMM

C

Used by: CMAQ, RAMS

- Schedule
 - June 2003 – Begin initial system tests at NOAA/NCEP during 2003 ozone season
 - Northeast US domain
 - 12km grid cells
 - 1-day forecast – O₃
 - October 2003-May 2004 – Refine system for NCEP operations
 - May 2004 – Begin operational real time test and evaluations at NOAA/NCEP
 - September 2004 – Initial operational Eta-CMAQ forecast system for Northeast US

Extending the Operational Capability

- Moving to PM_{2.5} Forecasting
 - What metrics are of interest for short-term forecasts?
 - 24-h average; daily max
 - Data for evaluation; initial/boundary conditions
 - Observation networks are relatively new
 - Total mass; speciated mass issues
 - Emissions inventories and uncertainty
 - Improving the science processes
 - Model efficiency for forecasts

- Transitioning to on-line meteorology-air quality modeling
 - Weather Research and Forecast (WRF) Model
 - Next-generation mesoscale meteorological model
 - NCAR, NOAA, and others collaborating
 - 2004-2006 operational timeframe at NOAA/NCEP
 - Integrating chemistry on-line with meteorological modeling
 - WRF-Chem
 - Testing to start after WRF is operational

- Advantages over off-line linked modeling
 - Improved mass consistency
 - High frequency of communication between meteorology and chemistry processes
 - Potential for feedbacks from air quality simulation to meteorology (aerosol-related)
 - Radiation
 - Cloud microphysics

- Potential disadvantages
 - Additional computational burden for single model run
 - Delay in producing meteorological forecasts
 - Unless separate runs are performed in parallel

Summary

- NOAA/EPA collaboration on numerical modeling system for AQ forecasts
- Initial operational capability (IOC) for 1-day O₃ forecasts for Northeast U.S. to start September 2004 at NOAA/NCEP
- AQ forecast capability to be extended in stages to include:
 - Nationwide coverage
 - PM_{2.5} forecasts
 - 2-3 day forecasts
 - On-line met/chem modeling